2003

Summary of the Impacts of Urbanization on Selected Maine Streams Detected by the Maine DEP

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Partnership for Environmental Technology Education

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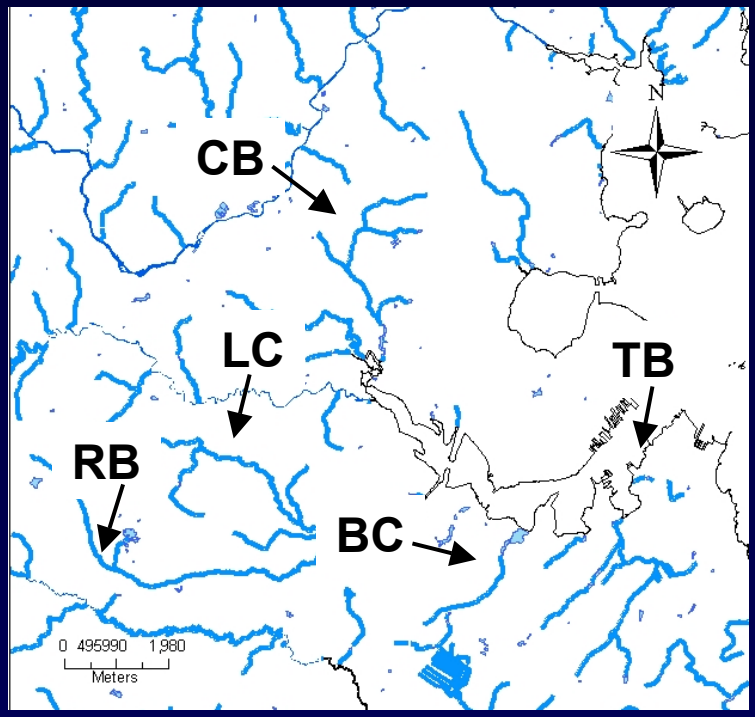
Presentation Objectives

- Present data collected from 2 reference and 8 study streams in Maine
  - biological data
  - physical and chemical data
  - hydrological and habitat data
- Summarize findings
- Where we go from here

Map of Study Streams

Portland Area Streams



Portland: Capisic Brook

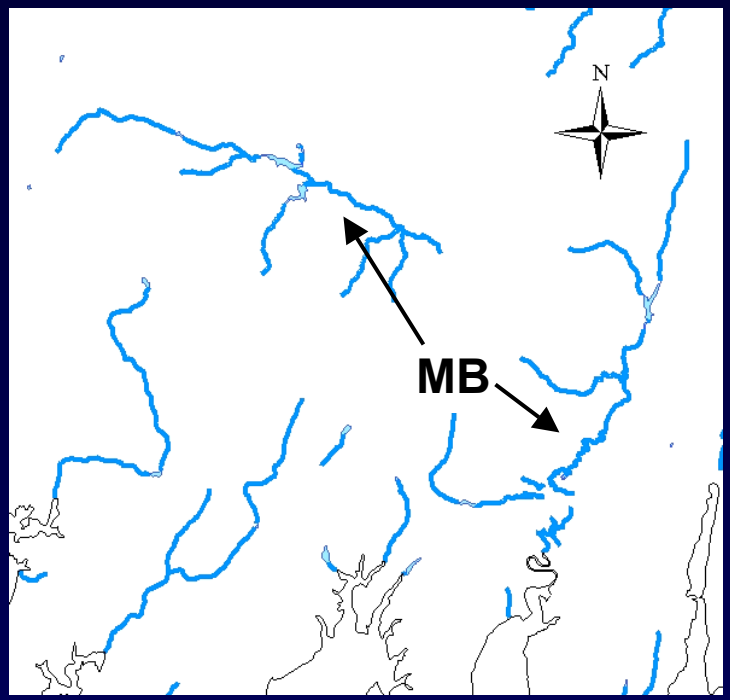
South Portland: Long Creek

Trout Brook Barberry Creek

Scarborough: Red Brook

Map of Study Streams

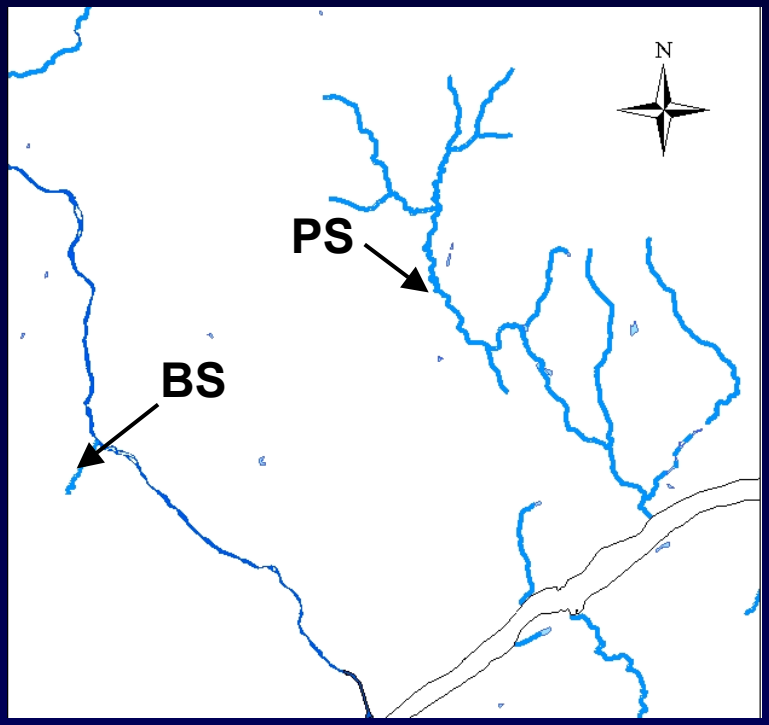
Brunswick Stream



Mare Brook

Map of Study Streams

Bangor Streams



Birch Stream

Penjajawoc Stream

Reference Sites

Red Brook,
Scarborough

May 1999

Capisic Brook,
Portland

Upstream, July 2003

Urban Sites

Long Creek,
South Portland

North Branch
June 1999

Mainstem
Dec. 2000

South Branch
June 1999

Urban Sites

Capisic Brook,
Portland

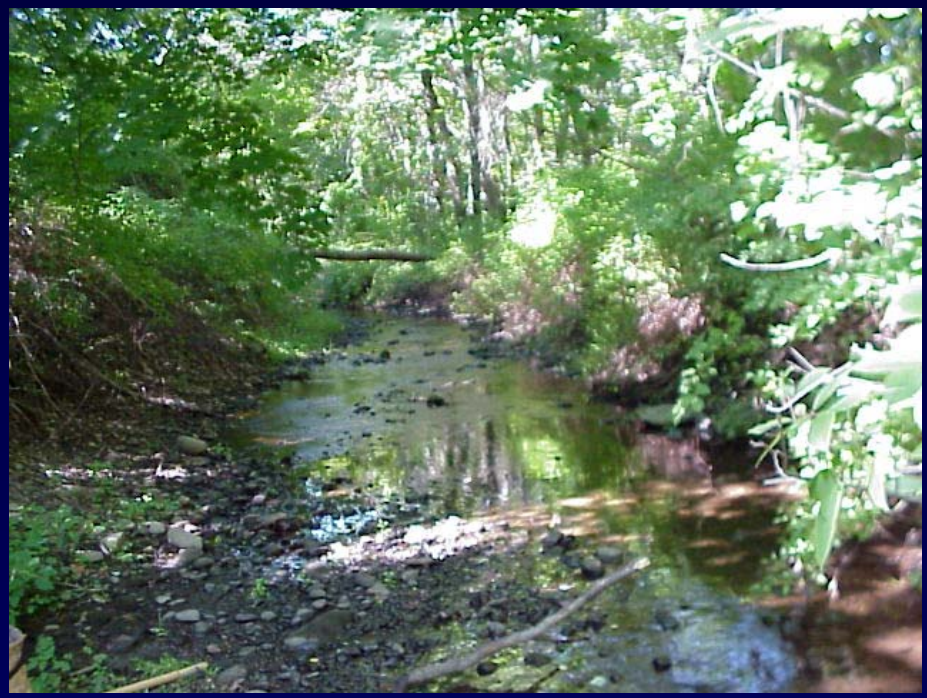
Downstream
September 2003

Barberry Creek,
South Portland

August 2003

Urban Sites

Trout Brook, South Portland



Upstream
September 2003

Downstream
June 2003

Urban Sites

Birch Stream, Bangor

Upstream
Summer 1999

Downstream, July 2003

Urban Sites

Penjajawoc Stream, Bangor

July 2003

Maine's Water Classification Program

- Defines water quality classifications for fresh surface waters, as well as estuarine and marine waters.
- River and stream water classes:
  - **AA**, **A**, **B**, and **C**
- State legislature has assigned classes to every stream and river in the state.

Water Classification Criteria

	Narrative Criteria		Numeric Criteria	
	Aquatic Life (Biological)	Habitat	Dissolved Oxygen	Bacteria (*E. coli*)
Class AA	as naturally occurs	free flowing and natural	as naturally occurs	as naturally occurs
Class A	as naturally occurs	natural	7mg/L; or 75% sat.	as naturally occurs
Class B	support all aquatic species indigenous to the receiving water; no detrimental changes to the resident biological community	unimpaired	7 mg/L; or 75% sat.	427/100 ml (instan-taneous)
Class C	maintain the structure and function of the resident biological community	habitat for fish and other aquatic life	5 mg/L; or 60% sat.	949/100 ml (instan-taneous)

BioME Model

- BioME is a statistical model that uses biological data to predict the likelihood of a sample attaining classes **A**, **B**, **C**, or **NA**.
- BioME was developed and calibrated using:
  - 25 biological variables
  - 373 samples representing a range of conditions
  - 15+ years of data.
- For more information, see MDEP Biomonitoring website: www. state.me.us/dep/blwq/docmonitoring/biomonitoring /index.htm

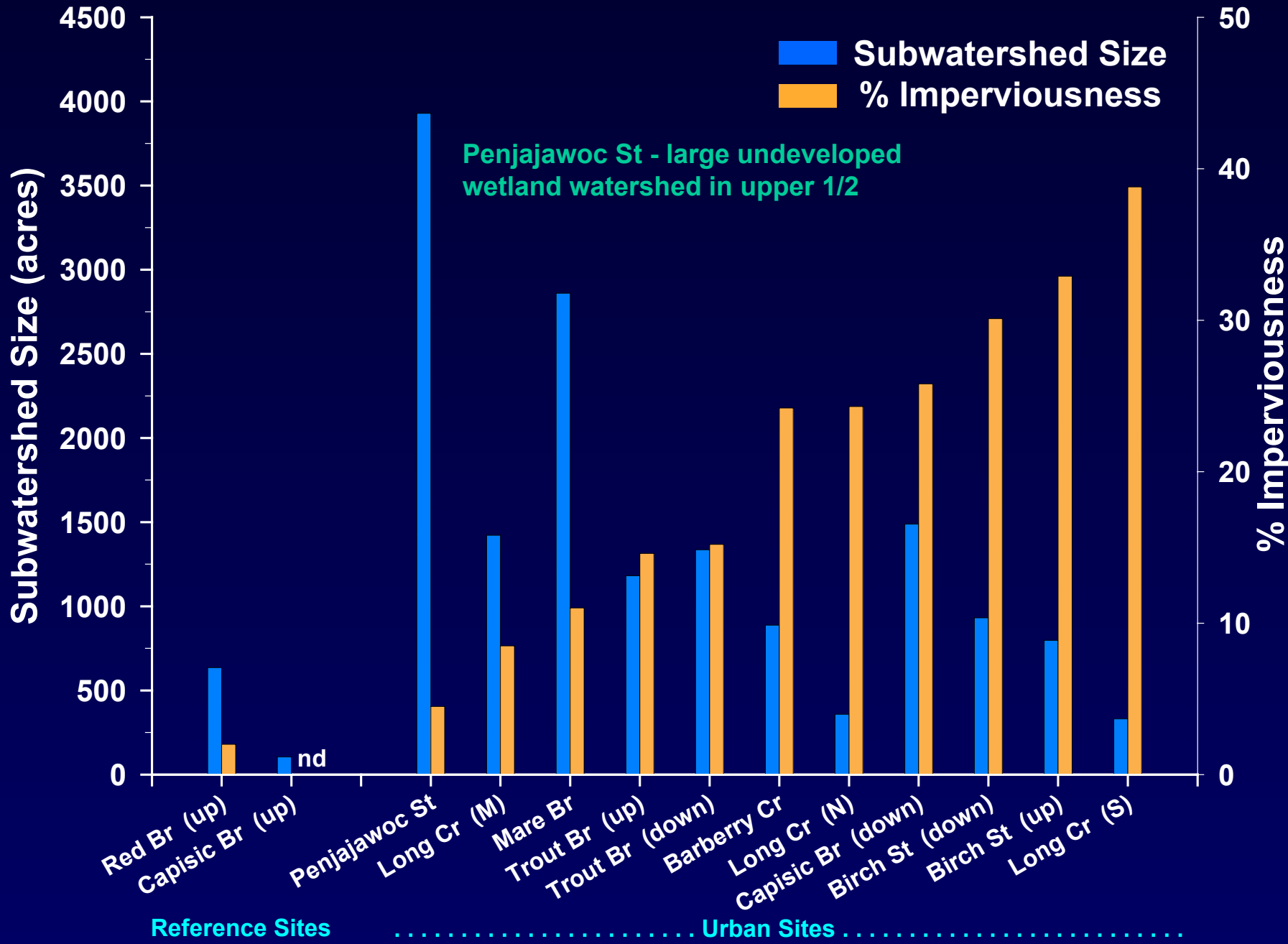
Comparison of Assigned Class versus Statistical Model Class

Reference Sites	Assigned Class	Statistical Model Class
Red Brook	C	A
Capisic Brook up	C	A, C

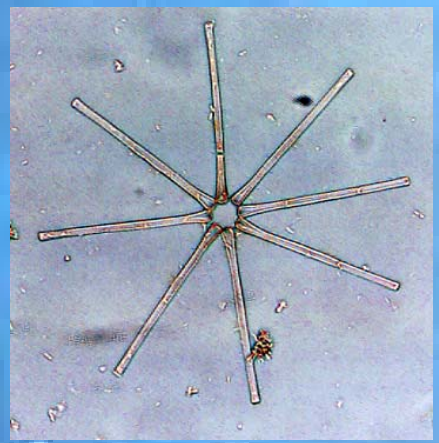
Urban Sites

		Assigned Class	Statistical Model Class
Long Creek	northern	C	NA
	mainstem	C	C
	southern	C	C
Capisic Brook	down	C	NA, NA
Trout Brook	up	C	NA, B, NA
	down	C	nd
Barberry Creek		C	NA
Birch Stream	down	B	NA, NA, C (NA)
	up	B	NA
Mare Brook		B	NA, NA
Penjajawoc Stream		B	NA, NA, NA

Subwatershed Size and % Imperviousness



Biological Data



Sensitive and Intermediate Species

Dragonflies and Damselflies

Mayflies

Stoneflies

Caddisflies

Tolerant Species

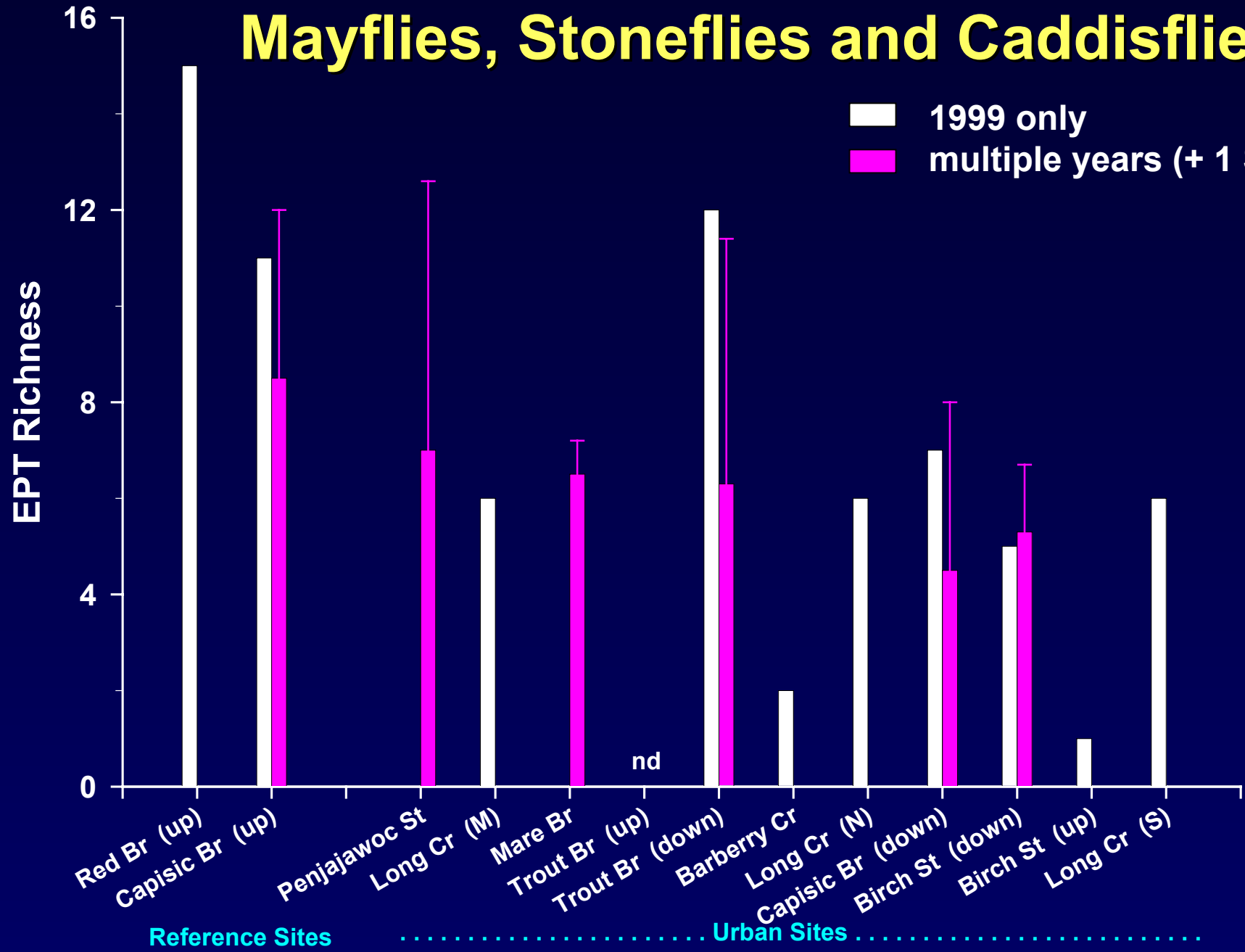
Scuds

Snails

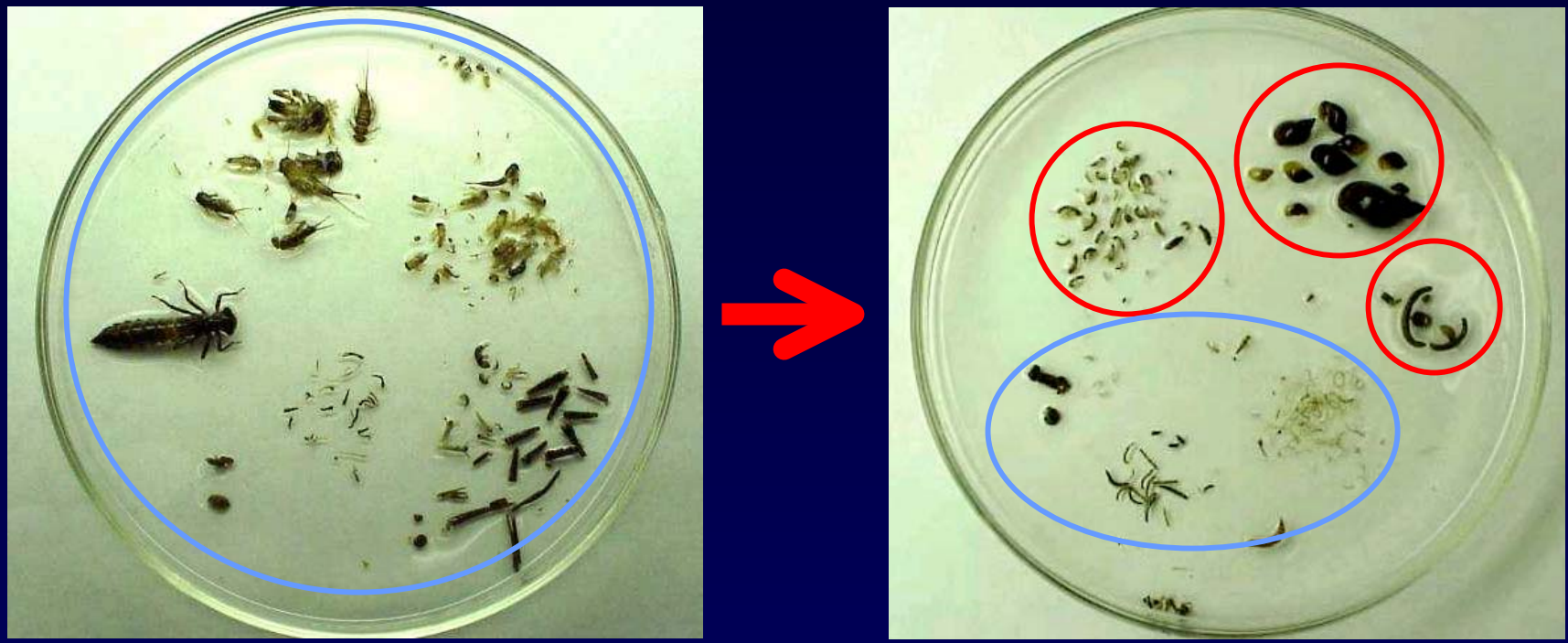
Leeches

Midges

Number of Different Kinds of Mayflies, Stoneflies and Caddisflies

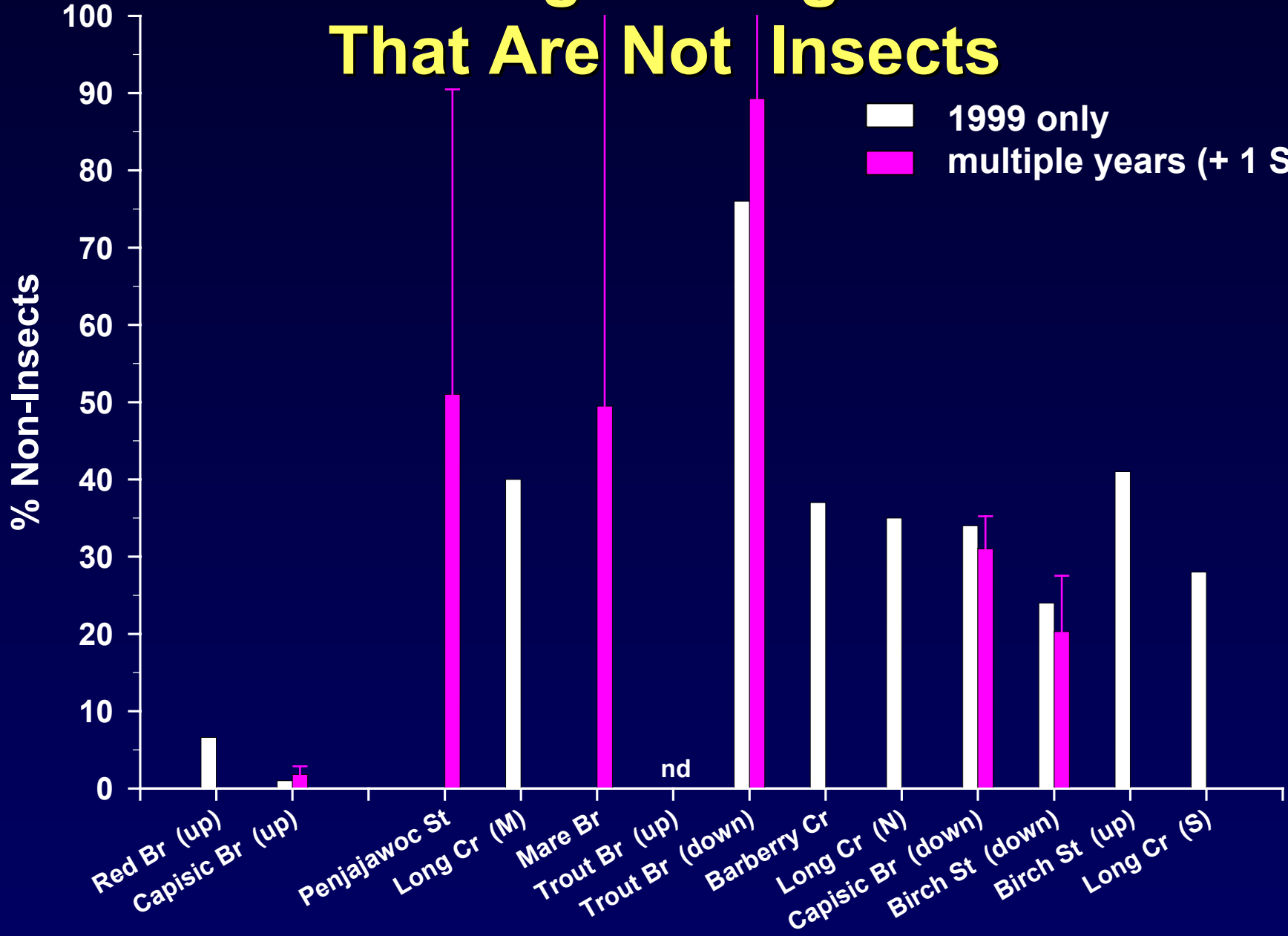


Reference versus Urban Streams

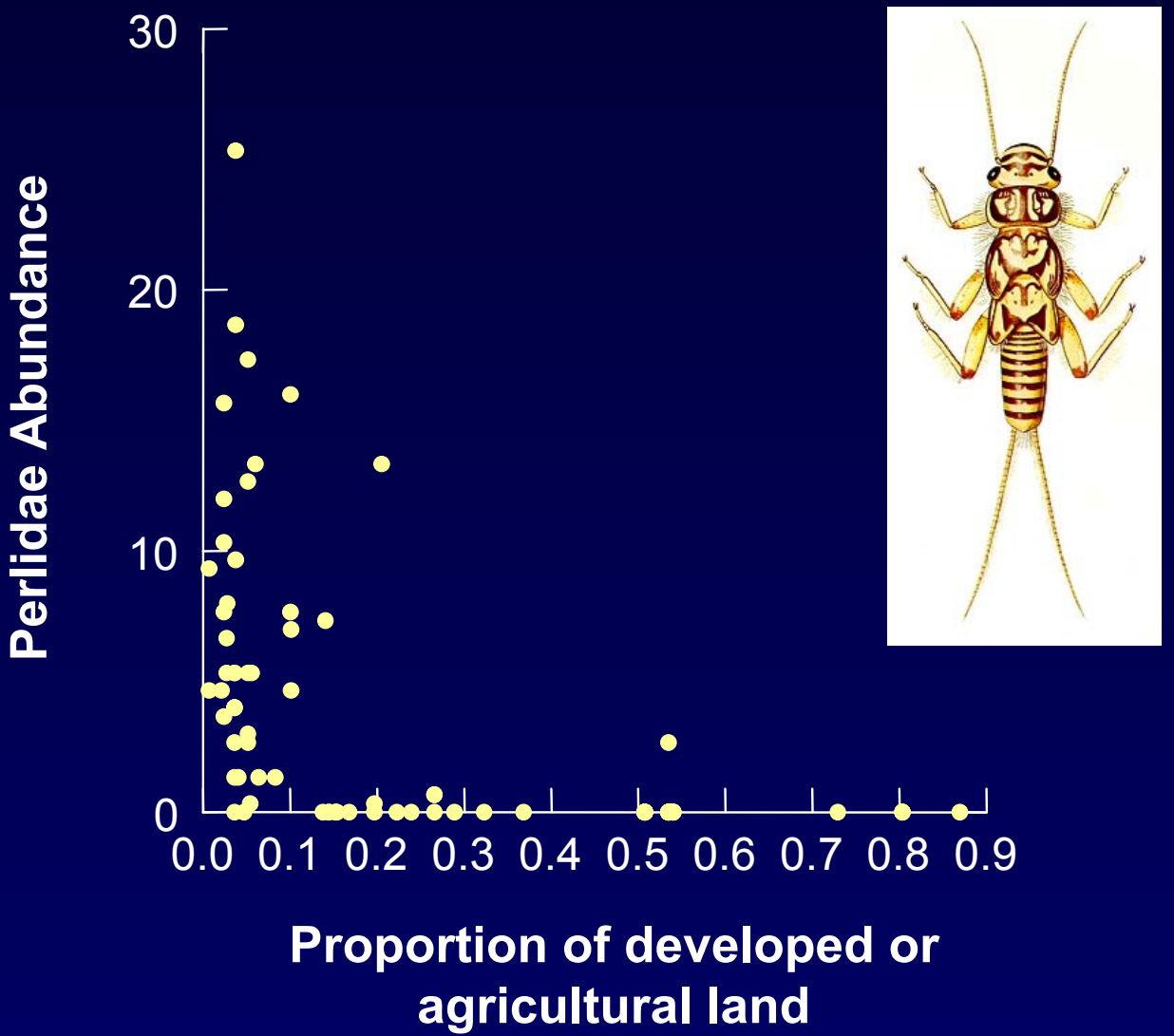


Shift from insect to non-insect taxa

Percentage of Organisms That Are Not Insects



Stonefly Abundance and Land Use



Abundance of Brook Trout

Brook Trout Abundance (# / 100 m)

30
25
20
15
10
5
0

nd 0 0 nd nd 0 0 0 0 nd 0

Red Br (up)
Capisic Br (up)
Penjajawoc St
Long Cr (M)
Mare Br
Trout Br (up)
Trout Br (down)
Barberry Cr
Long Cr (N)
Capisic Br (down)
Birch St (down)
Birch St (up)
Long Cr (S)

Reference Sites . . . . . Urban Sites . . . . . .

Percentage of Motile Diatoms

% Motile Diatoms

75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0

nd nd nd nd nd nd

Red Br (up)
Capisic Br (up)
Penjajawoc St
Long Cr (M)
Mare Br
Trout Br (up)
Trout Br (down)
Barberry Cr
Long Cr (N)
Capisic Br (down)
Birch St (down)
Birch St (up)
Long Cr (S)

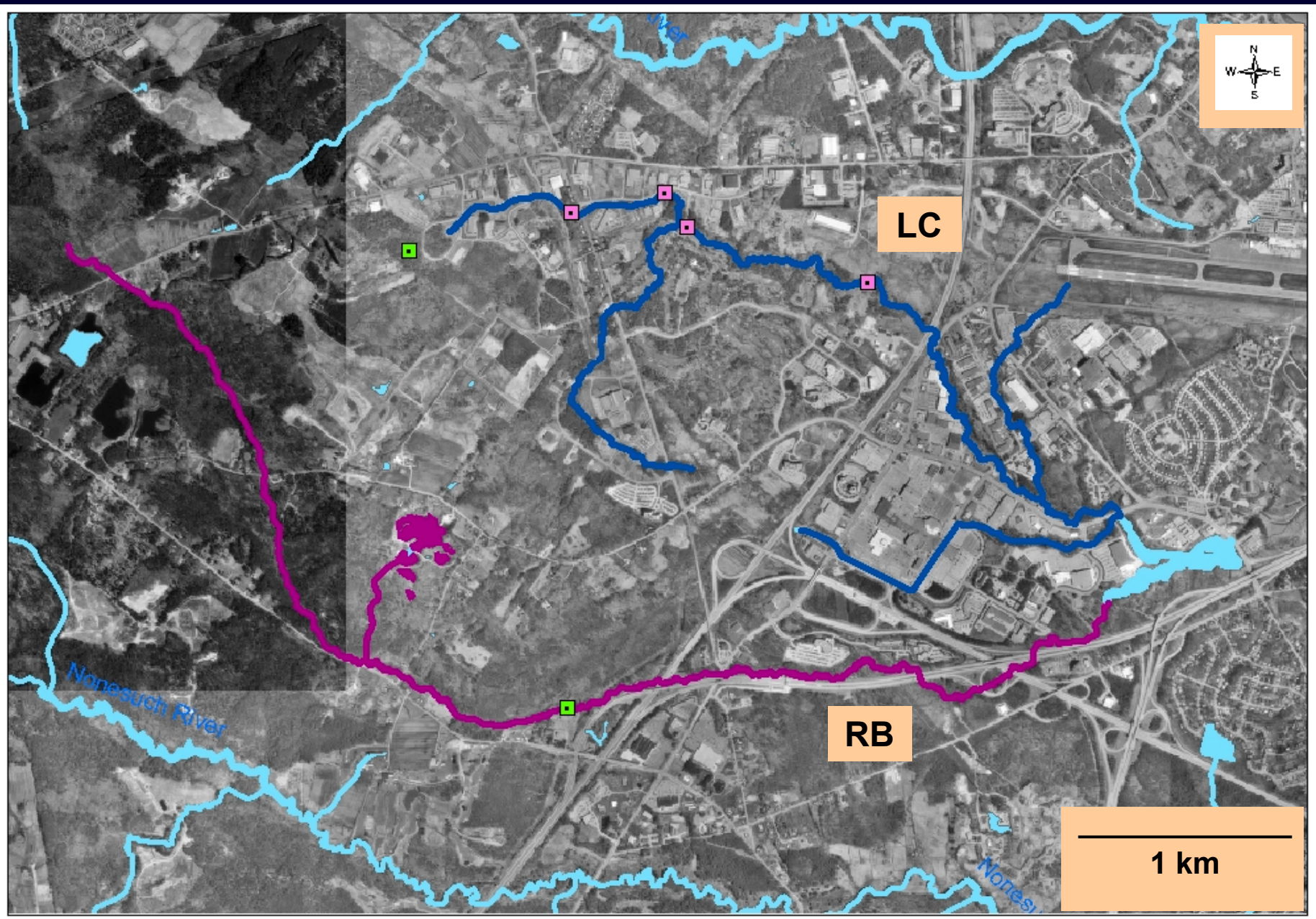
Reference Sites . . . . . Urban Sites . . . . . .

Physical and Chemical Data

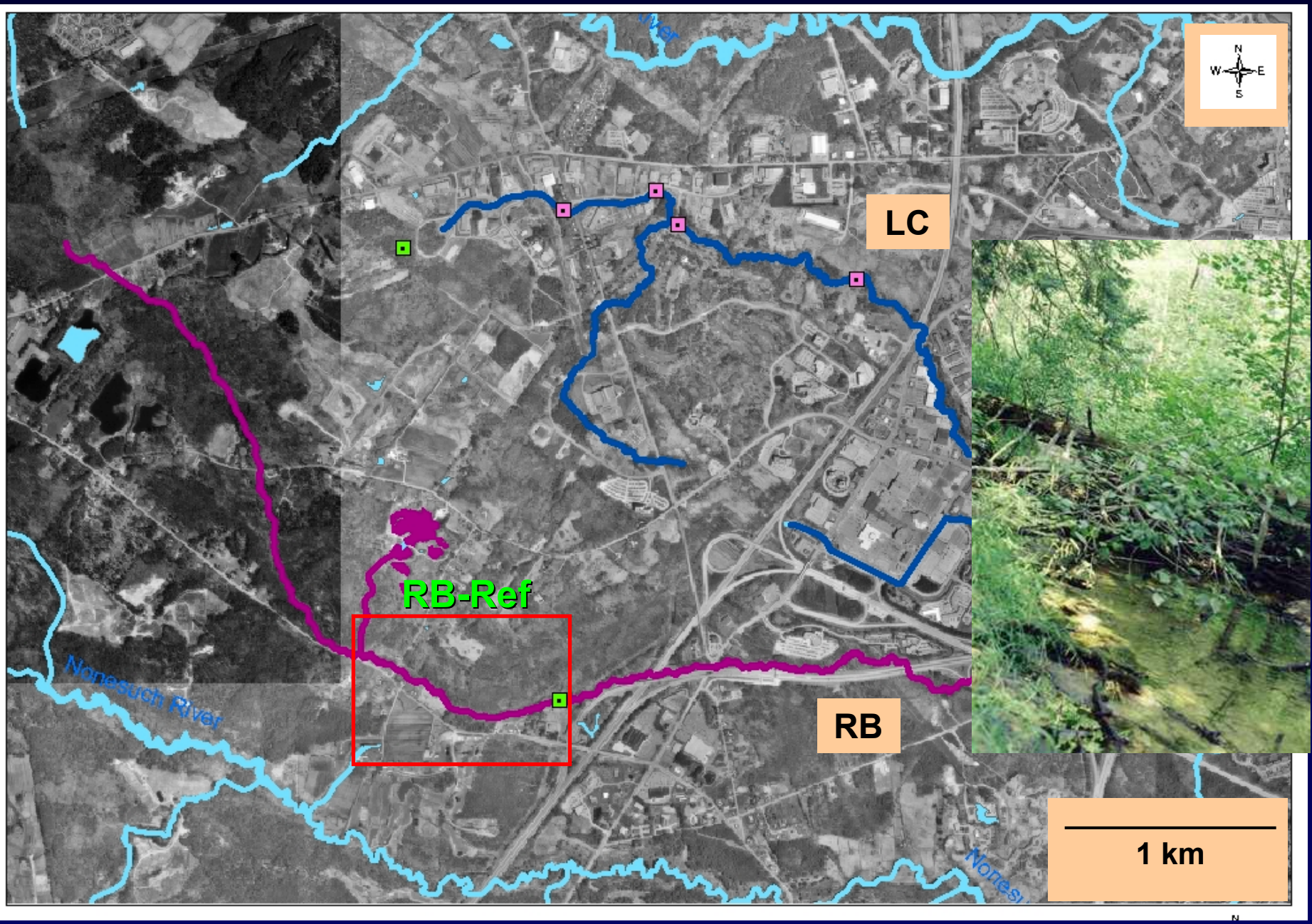
Temperature Study in Long Creek and Red Brook

Summer 2000

Aerial Photo of Study Streams and Sites



Aerial Photo of Study Streams and Sites



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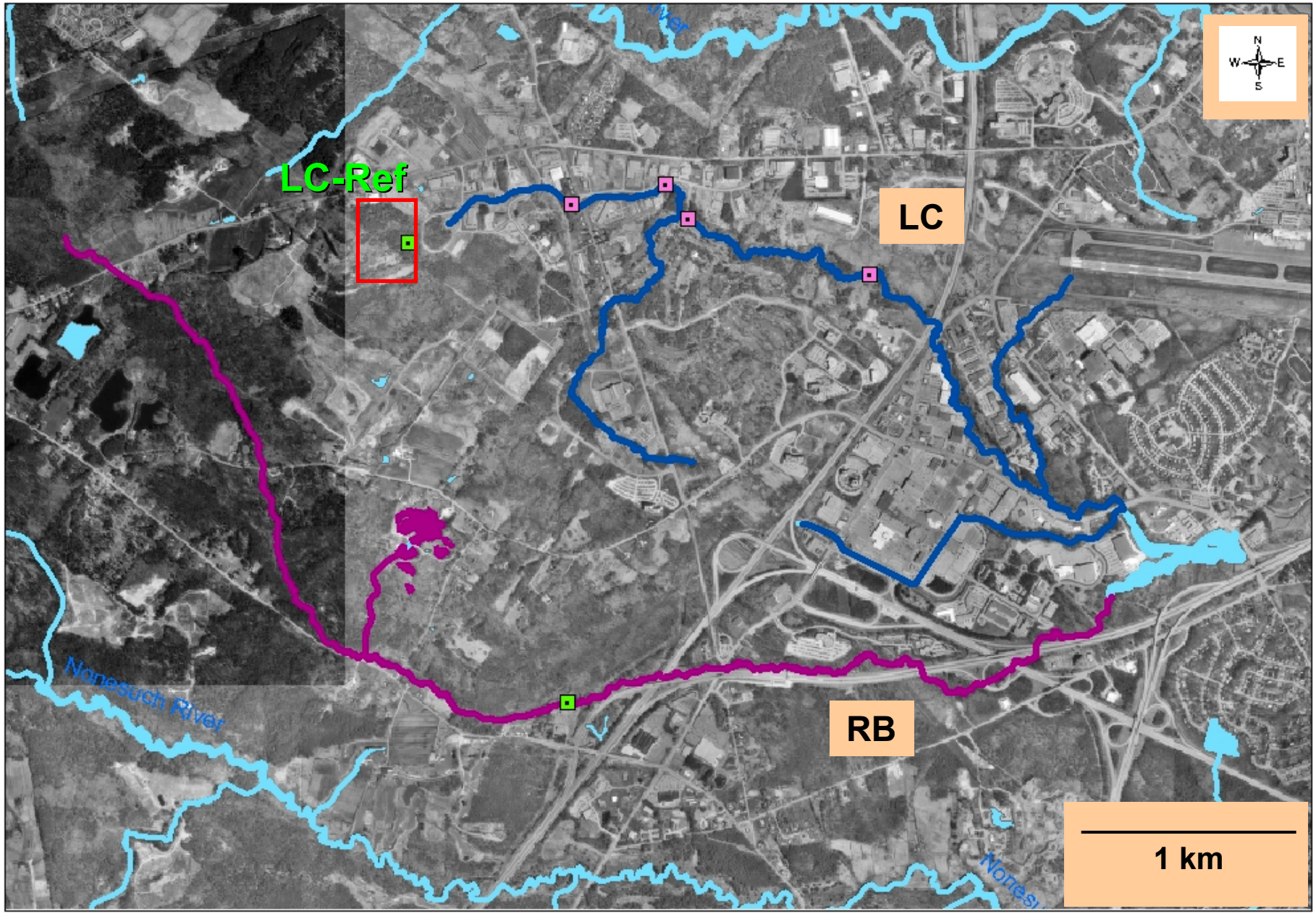
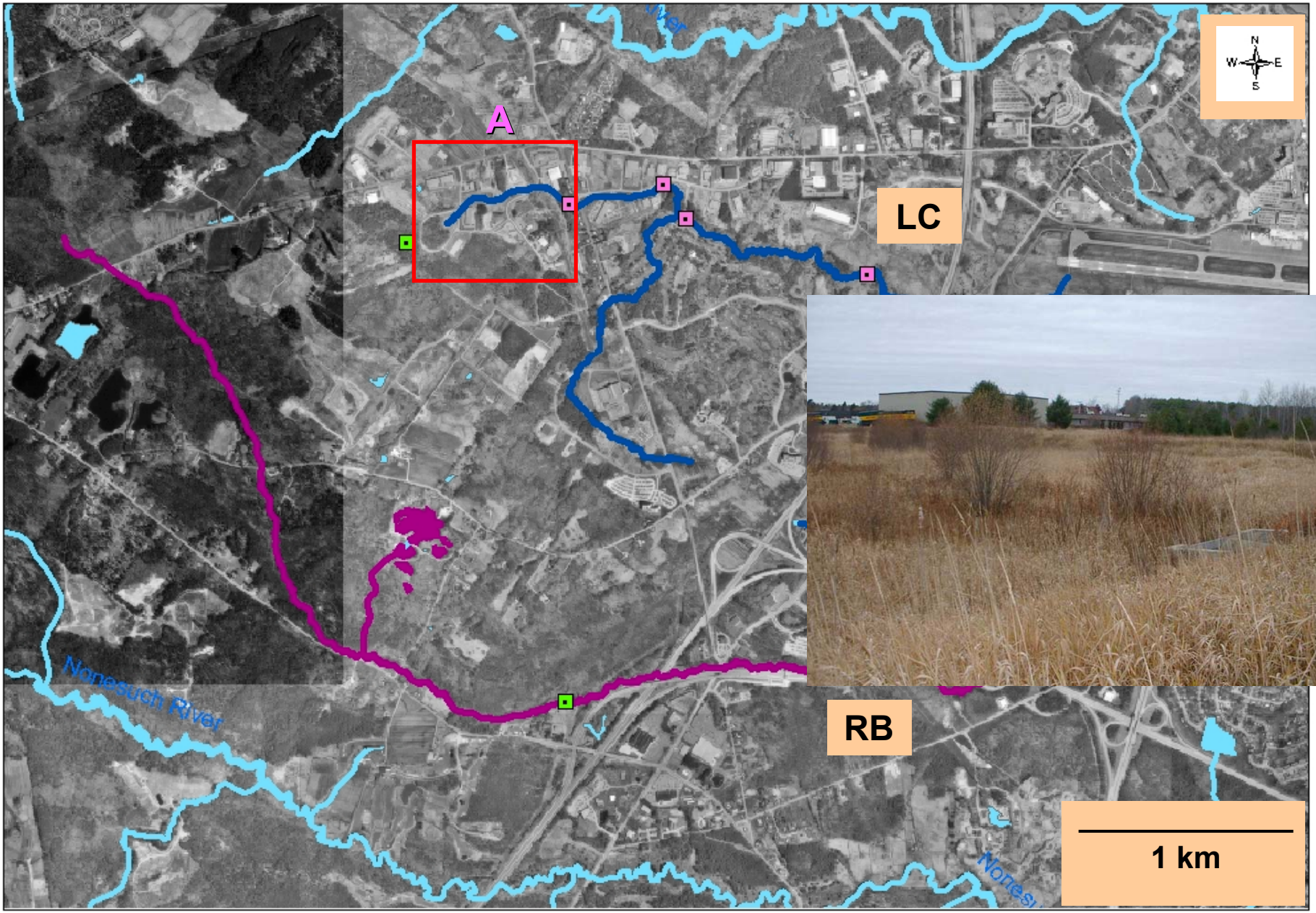


Aerial Photo of Study Streams and Sites



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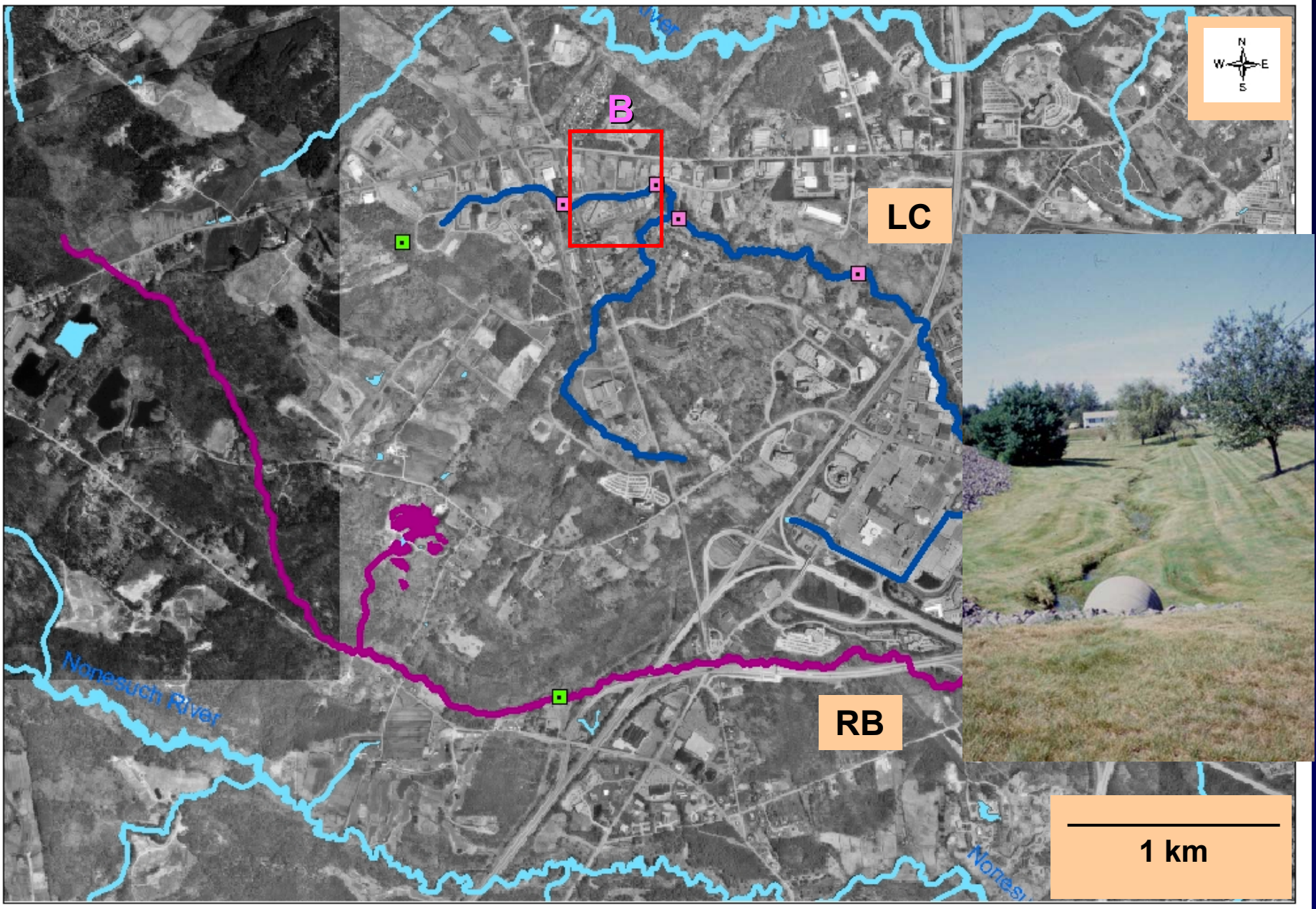

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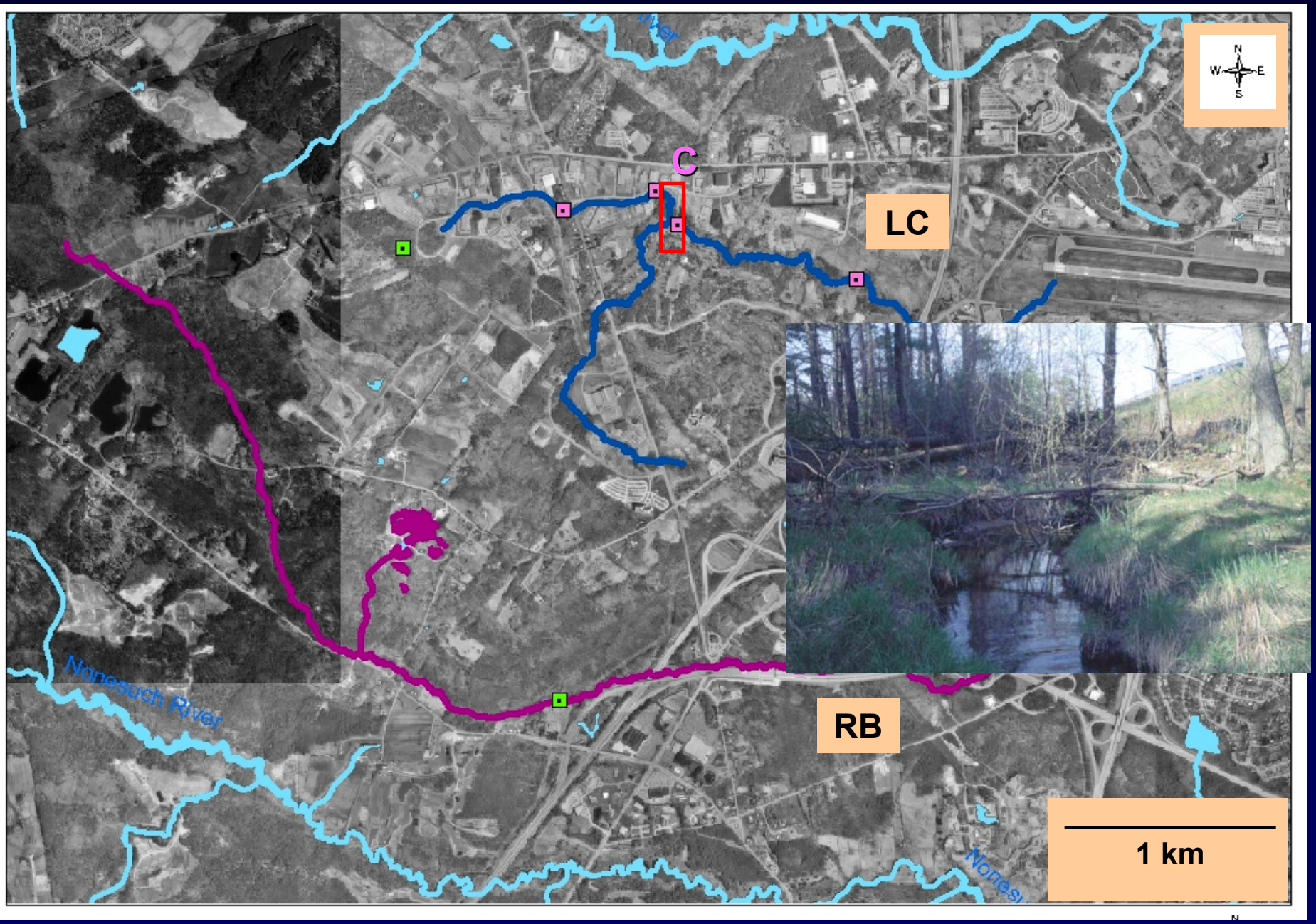
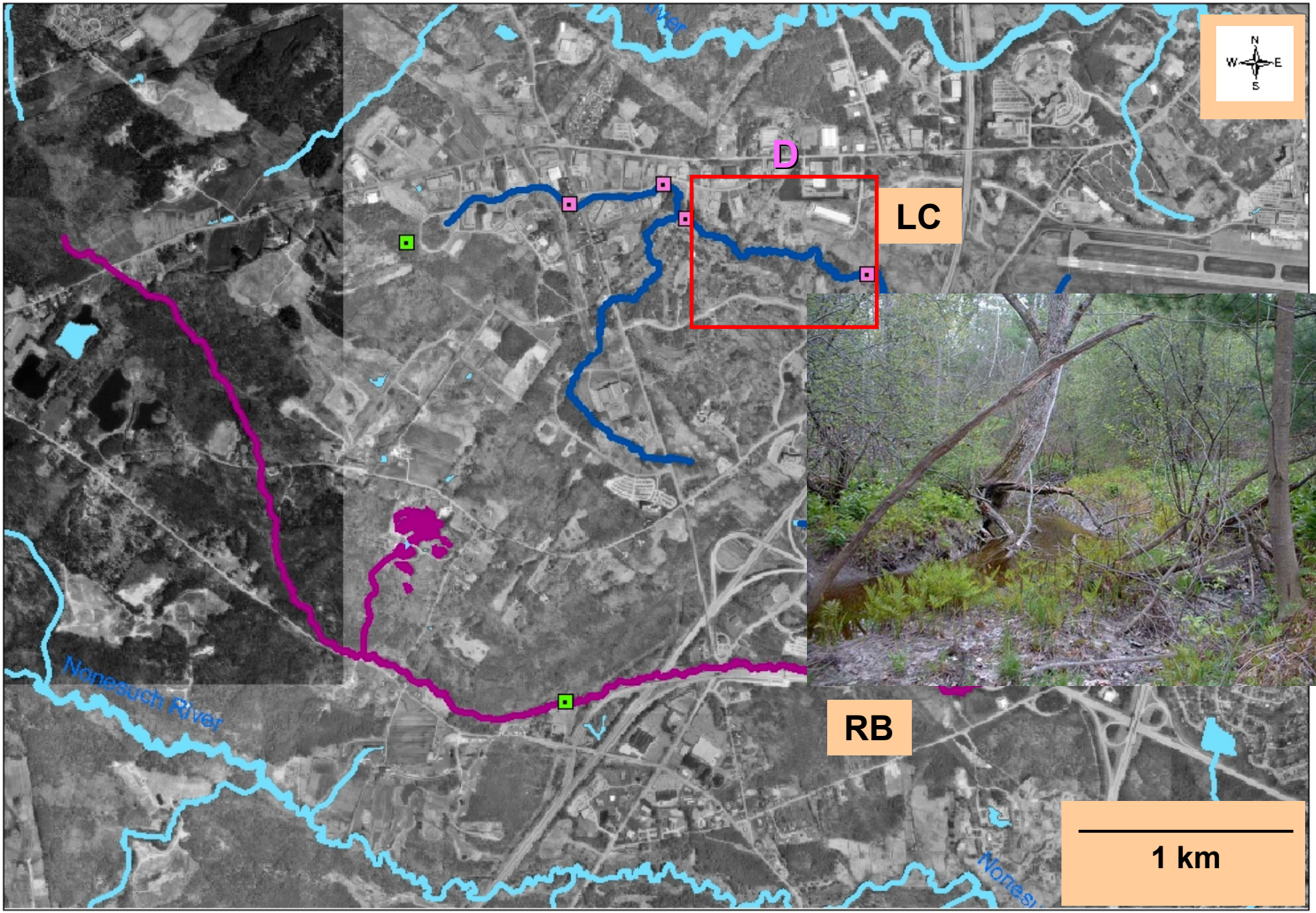
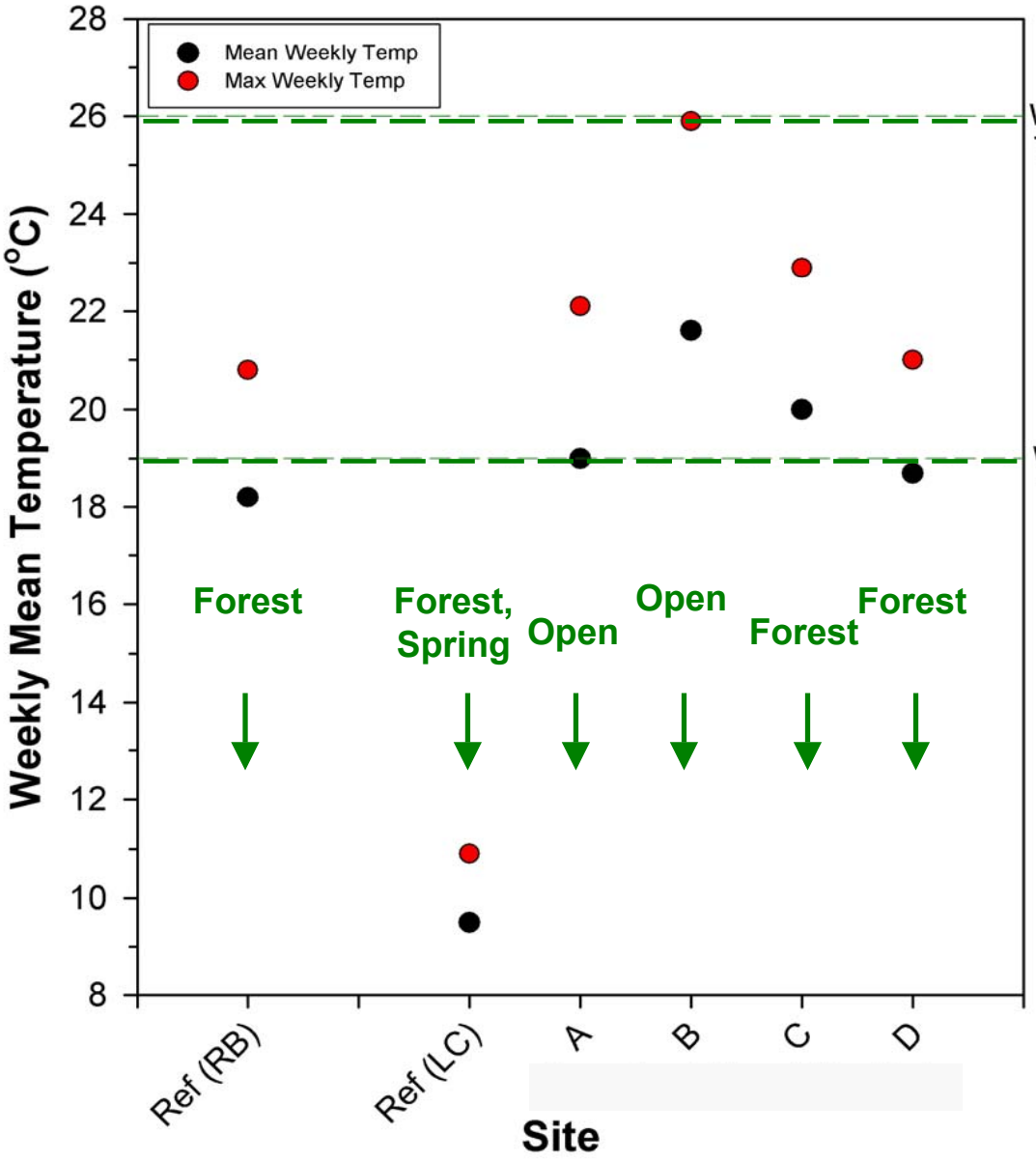


Aerial Photo of Study Streams and Sites



Temperature Data (week ending 7/1/2000)

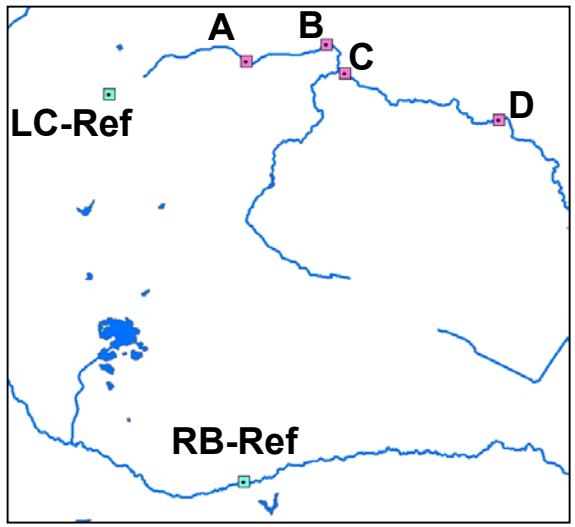


Upper Limit Weekly Mean Temperature

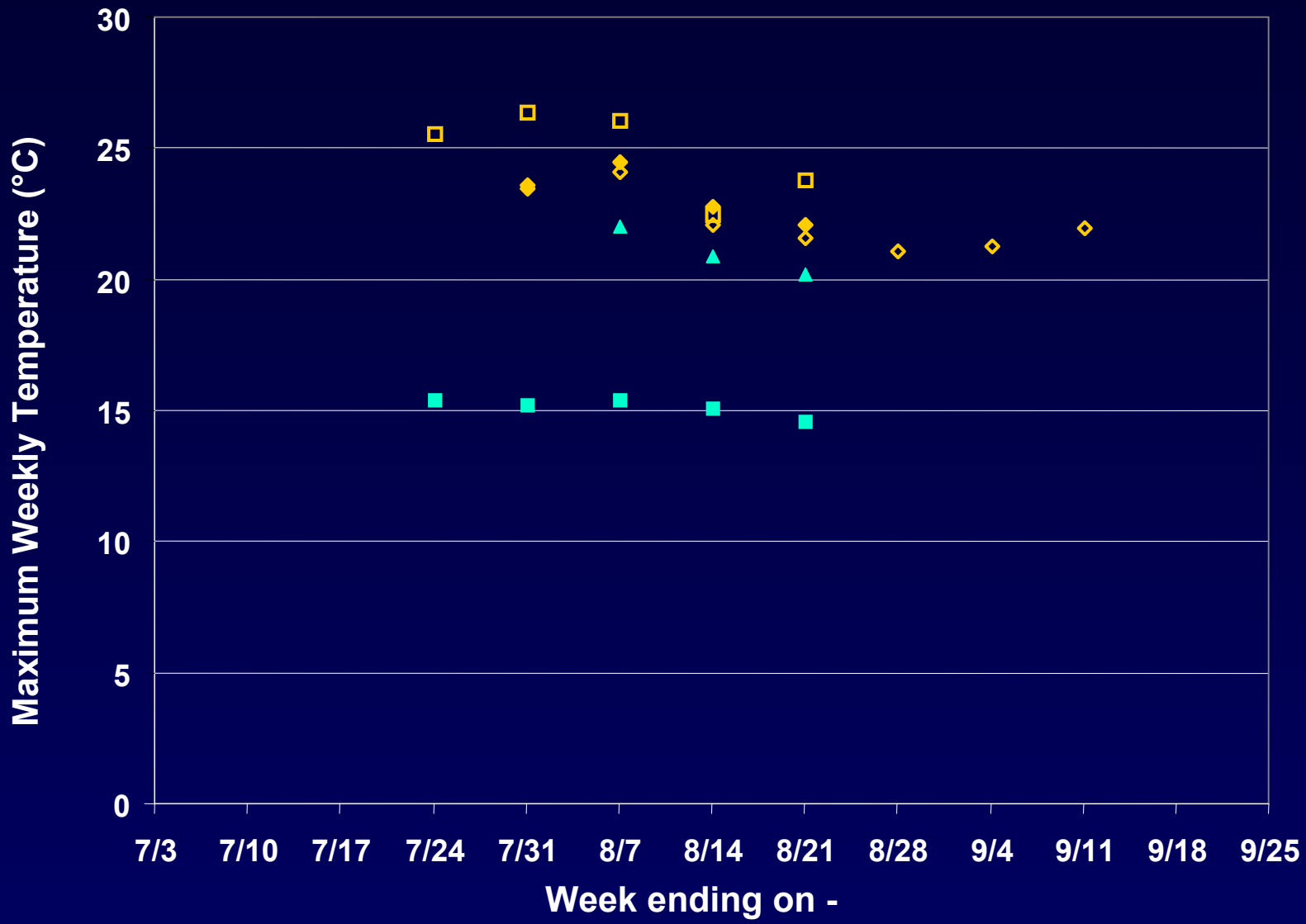
Brook Trout Upper Tolerances from Various Studies

Lower Limit Weekly Mean Temperature

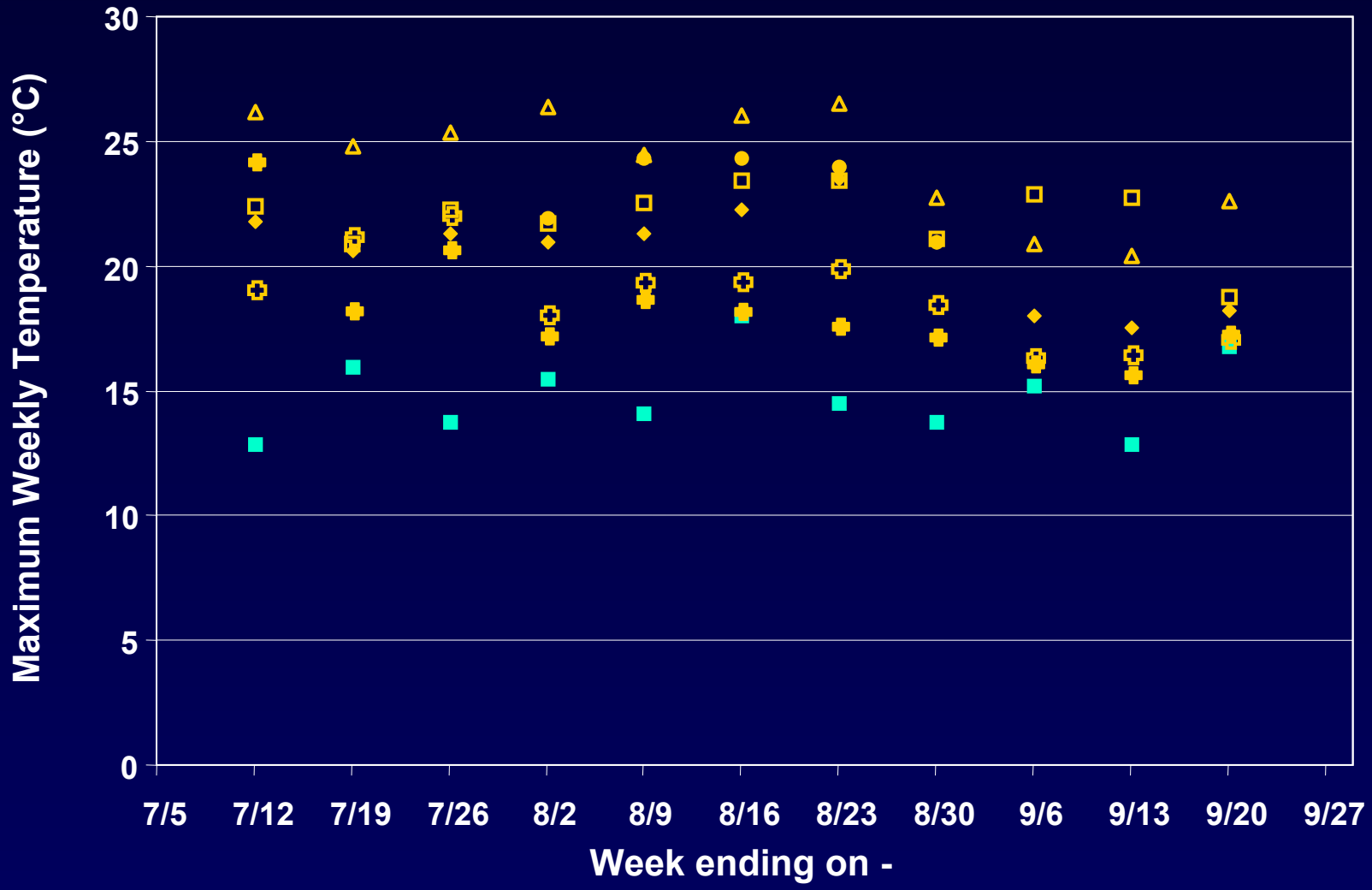
(Difference between RB-3.961 and RB-1.474 was approximately 2°C in 1999.)



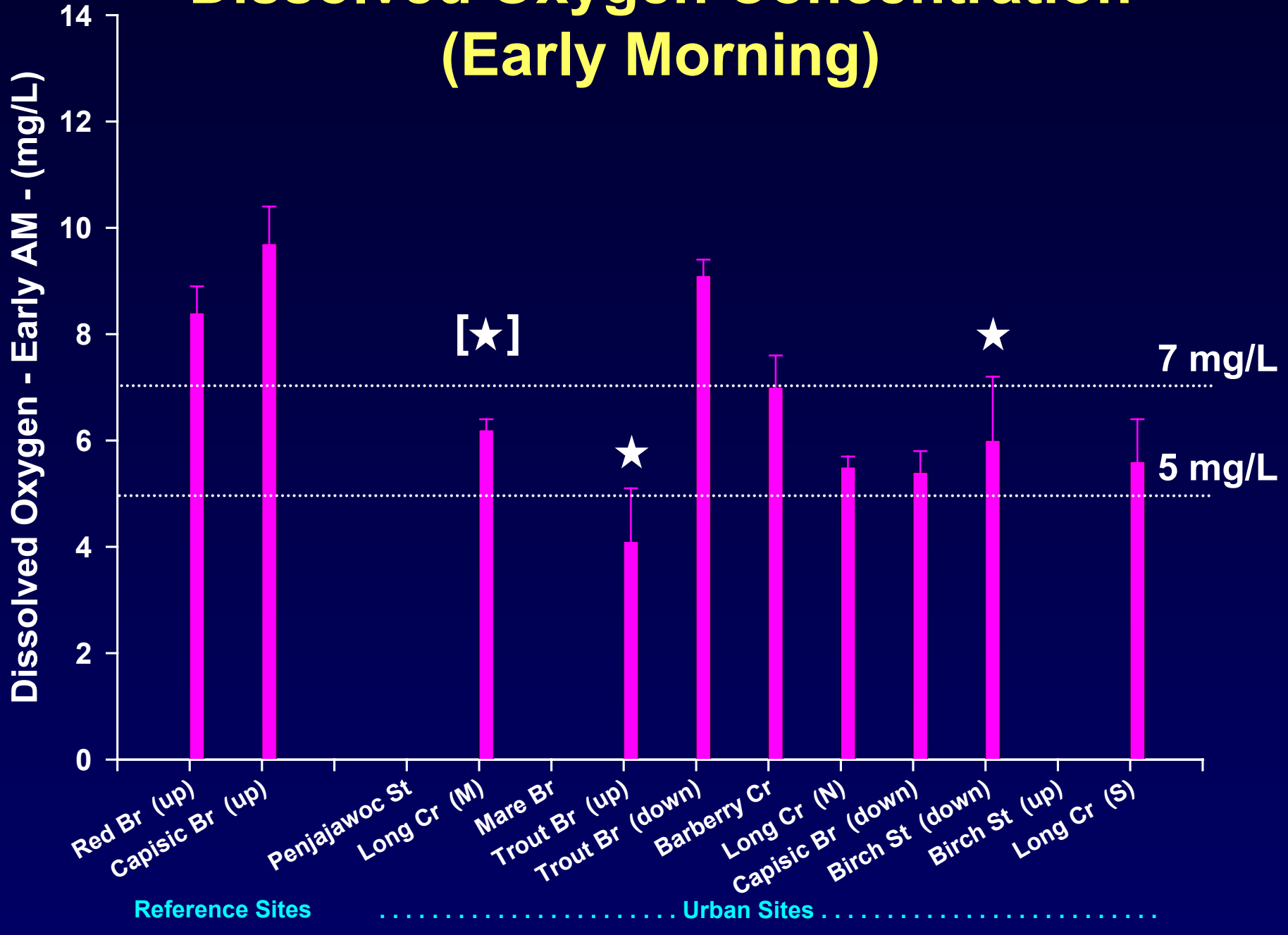
Maximum Weekly Temperatures, Summer 1999



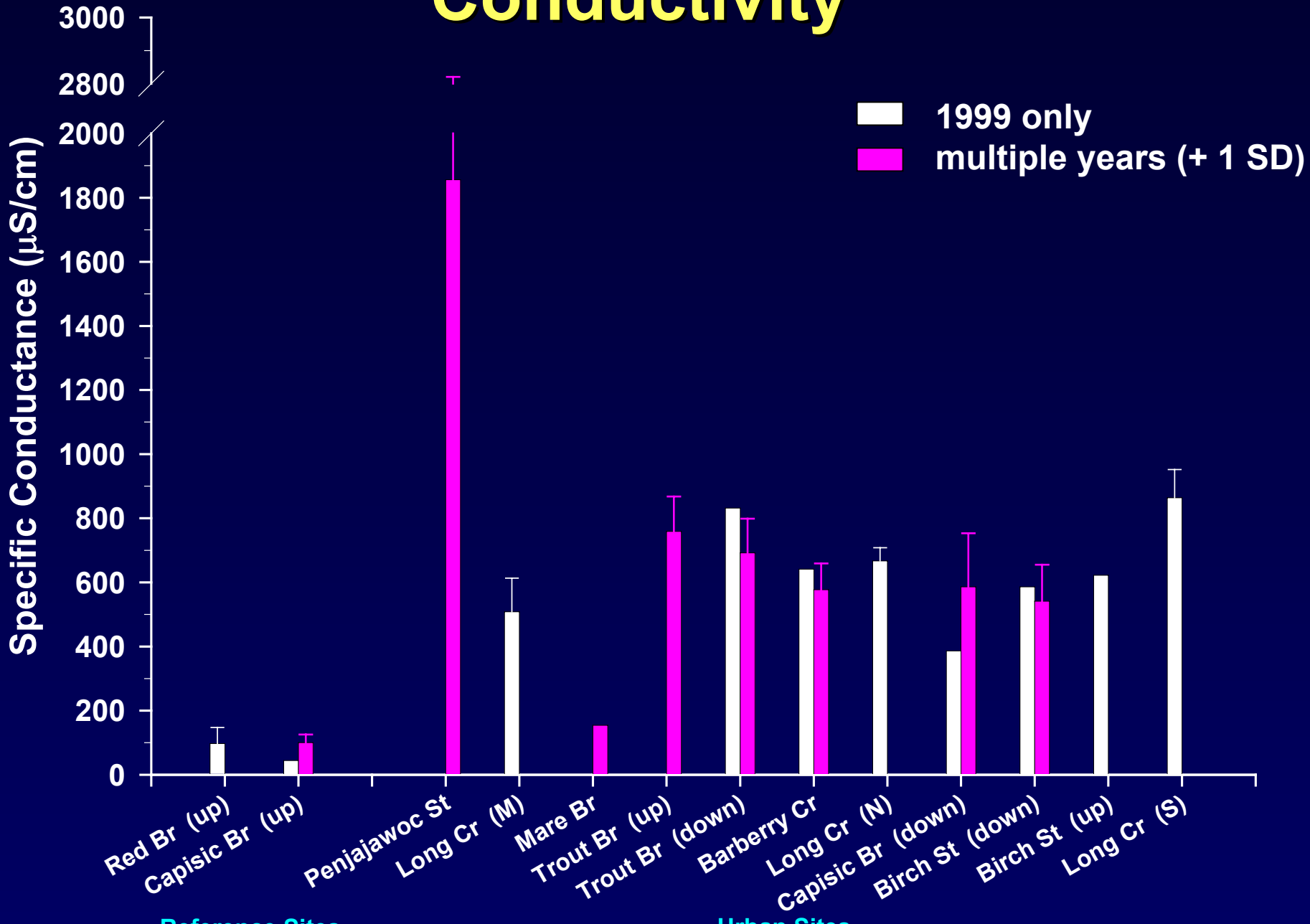
Maximum Weekly Temperatures, Summer 2003

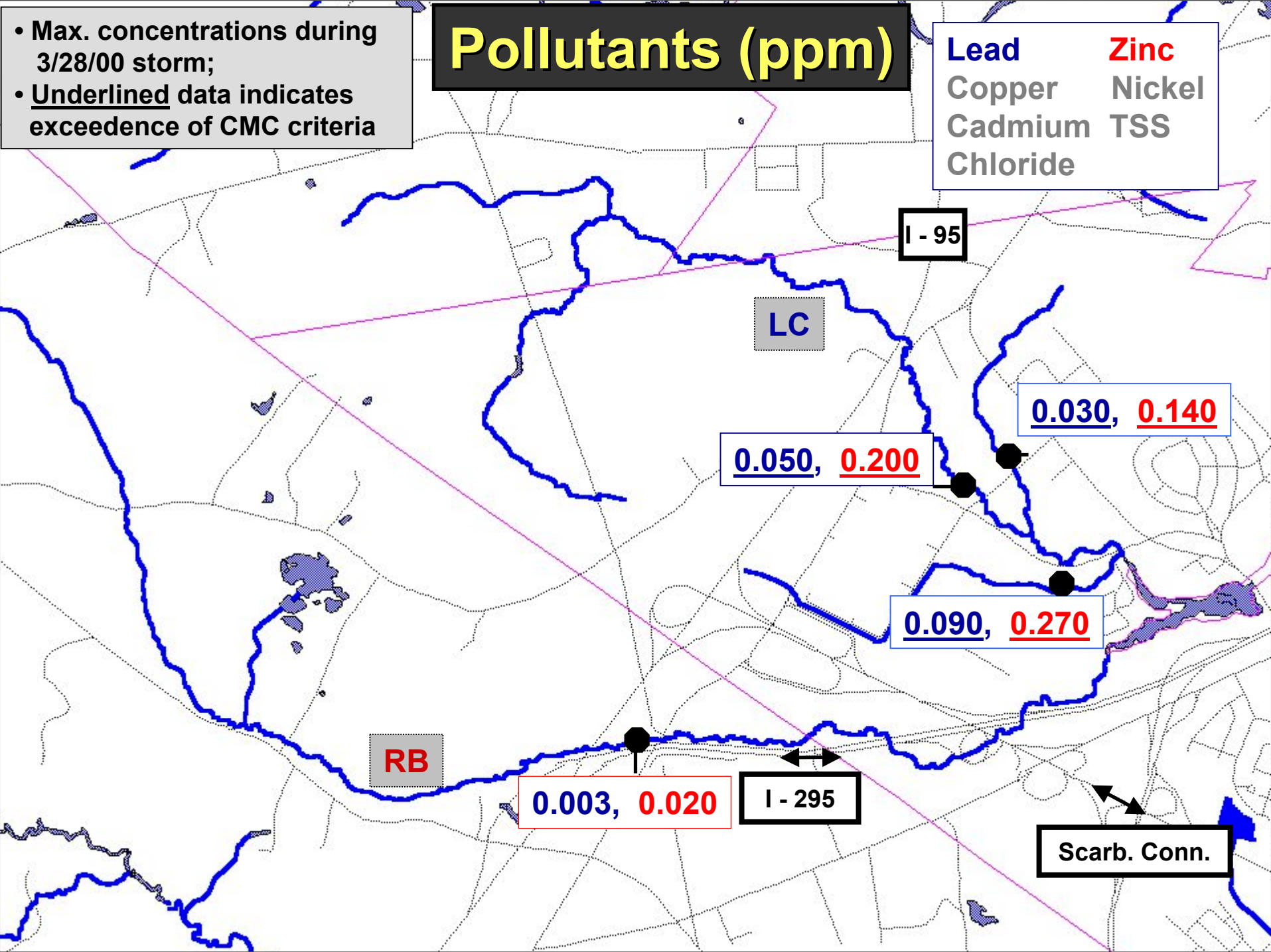


Dissolved Oxygen Concentration (Early Morning)



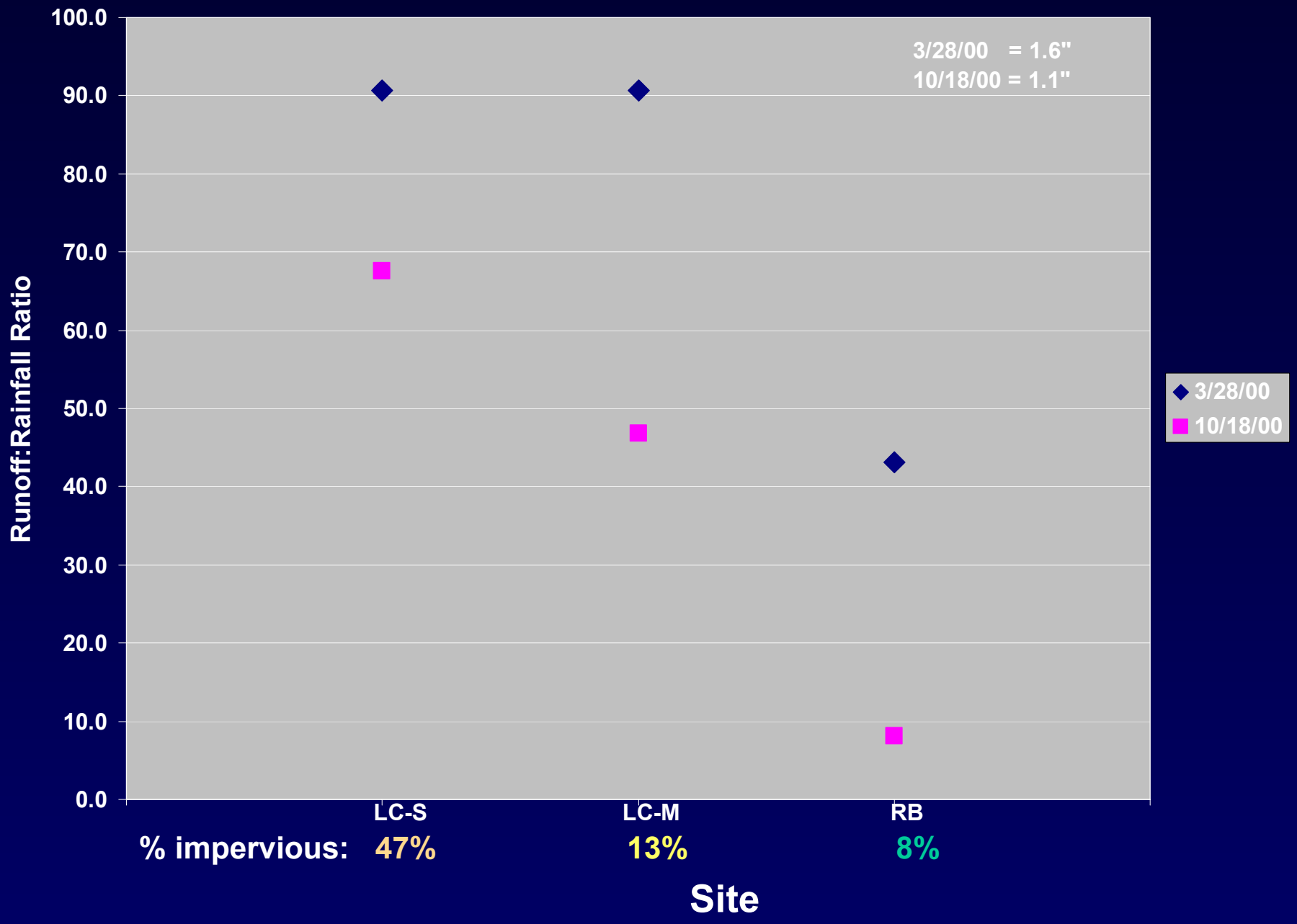
Conductivity



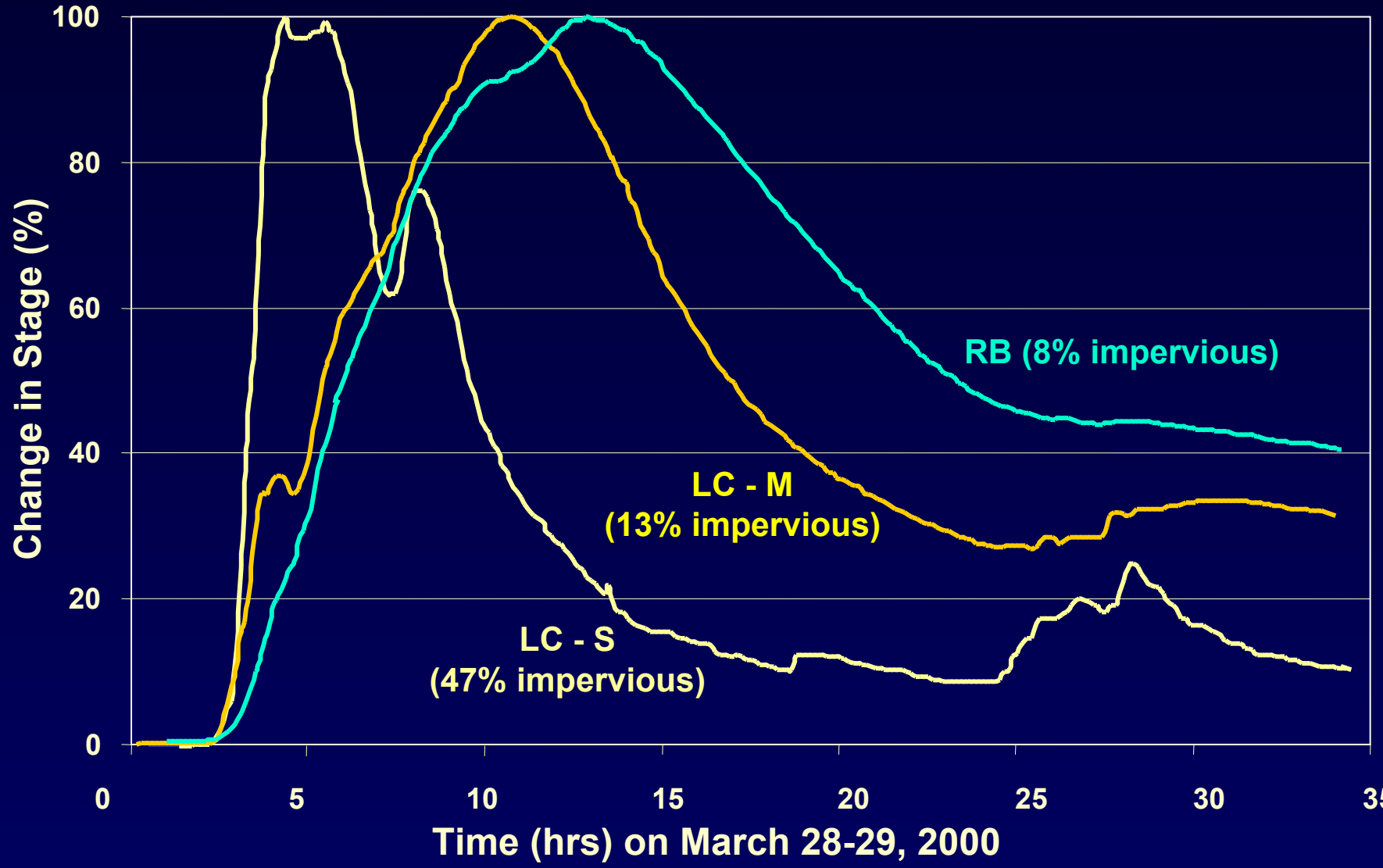

• Max. concentrations during 3/28/00 storm;
• Underlined data indicates exceedence of CMC criteria
Pollutants (ppm)
Lead
Zinc
Copper
Nickel
Cadmium
TSS
Chloride
I - 95
LC
0.030, 0.140
0.050, 0.200
0.090, 0.270
RB
0.003, 0.020
I - 295
Scarb. Conn.

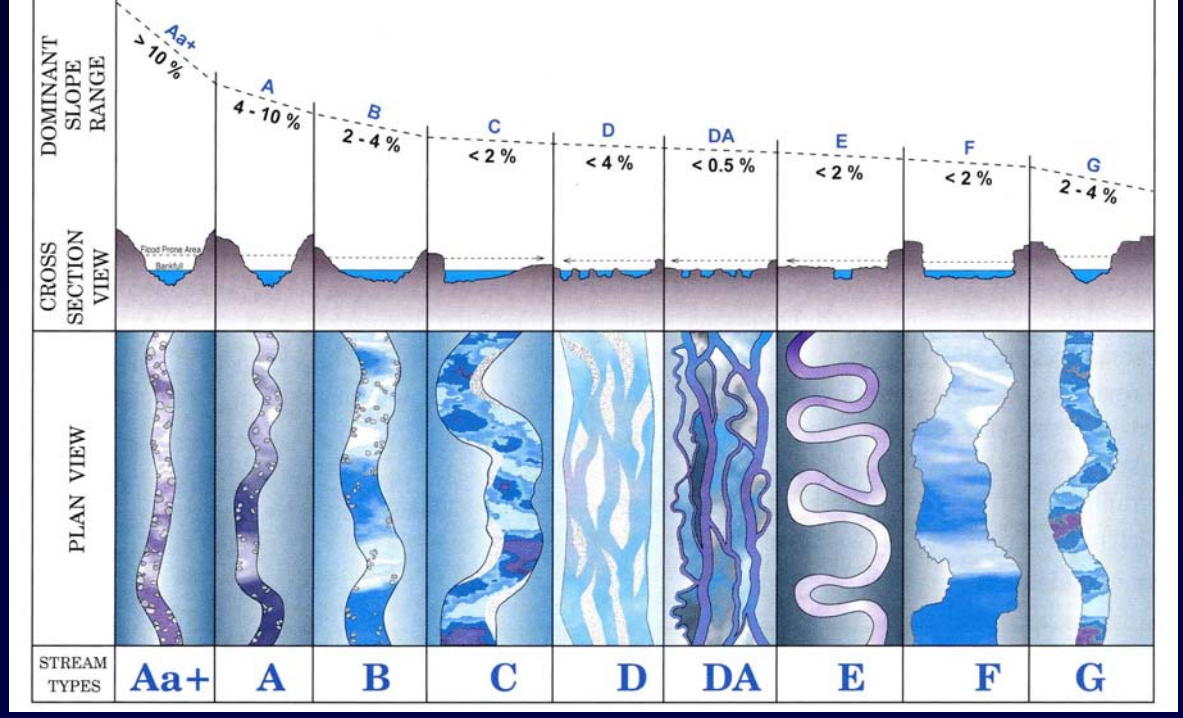
Hydrology and Habitat Data

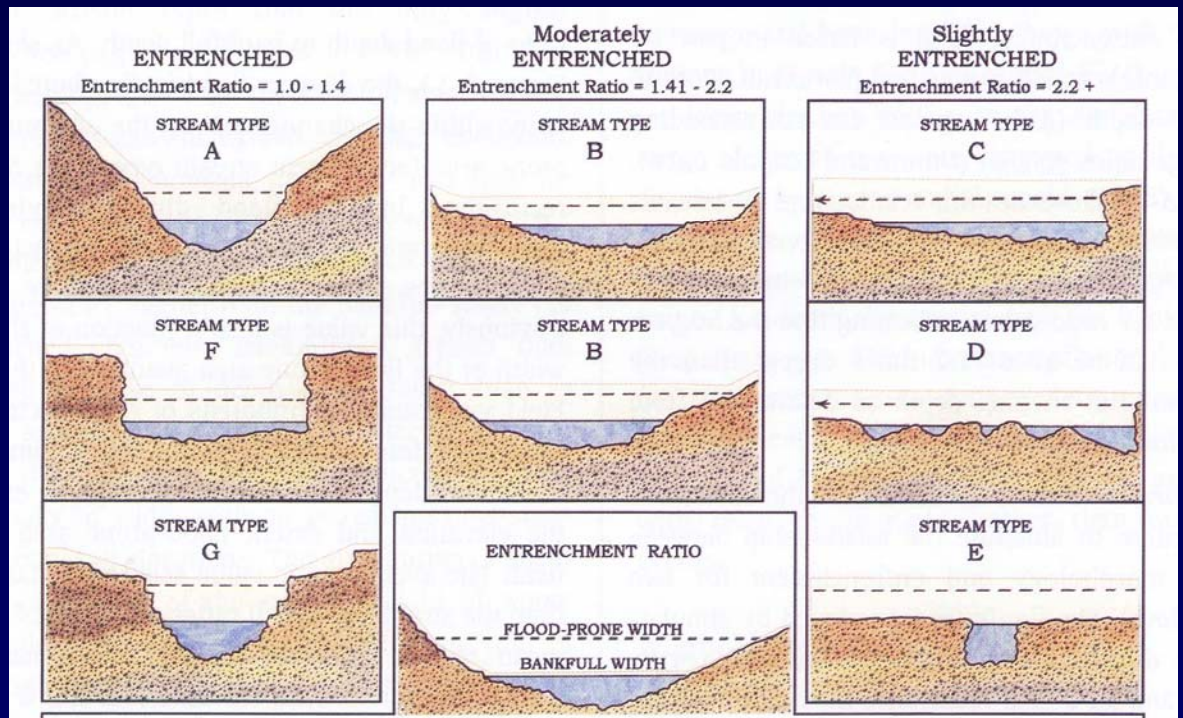
Runoff : Rainfall Ratio



Discharge Data



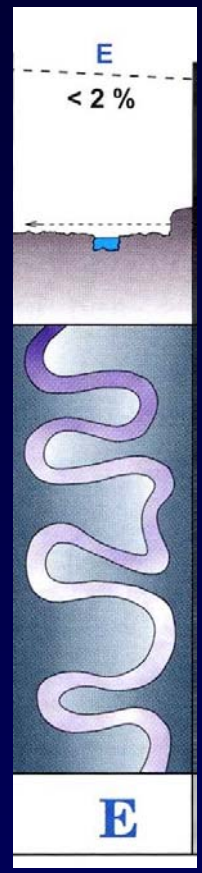


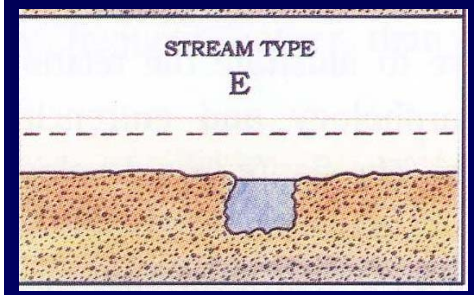


Natural Stream Classification System (Rosgen 1996)

Rosgen Stream Classification

Stream/Site	Rosgen Classification
LONG CREEK SITES	
Jetport Tributary (LC-N)	
LC-N-0.404	C5 (disturbed)
LC-N-0.595	E5 (disturbed)
Main Stem Tributary (LC-M)	
LC-M-0.432	B5c (disturbed)
LC-M-0.603	G6c (disturbed)
LC-M-1.653	E5 (normal)
LC-Mn-2.274	E6 (disturbed)
LC-Mw-2.896	C6 (disturbed)
Maine Mall Tributary (LC-S)	
LC-S-0.220	E5 (disturbed)
LC-S-0.369	E5 (disturbed)
RED BROOK SITES (RB)	
RB-1.434	E5 (normal)
RB-2.119	E5 (normal)
RB-3.961	E5 (normal)



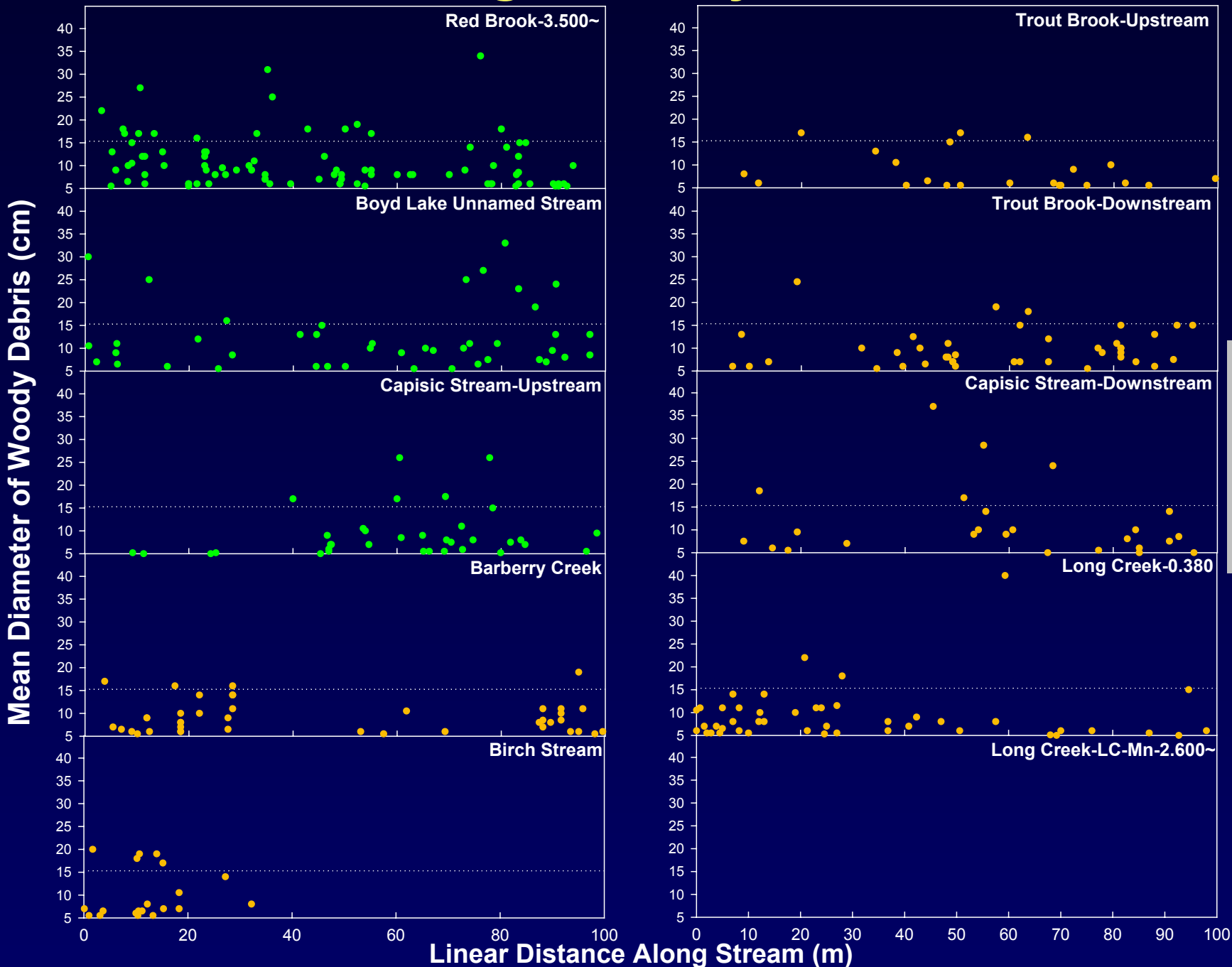


“Normal Channels”

“Disturbed Channels”

Large Woody Debris

Large Woody Debris



Summary

- Urban streams generally do not meet their assigned Water Quality Class while reference streams do
- Biological communities (macroinvertebrates, fish, algae) are altered with a shift to more tolerant species in urban streams
- Physical and chemical parameters (temperature, early morning DO, conductivity, pollutants) are usually degraded in urban streams
- Habitat parameters (runoff:rainfall ratios, discharge, channel structure, large woody debris) are in worse condition in urban streams
- ***But*** - not all is lost, most urban streams have something still going for them (low temperature, riparian buffer, concerned citizen groups), and there still are bugs and fish there

Where We Go From Here

- **Urbanization degrades streams in Maine**
  [MDEP Studies; Other Studies: Morse (2001), Woodcock (2002), Guay (2002), South Portland Engineering (1995) / Planning (1983)]

- **Likely restoration priorities:**
  - in-stream / riparian / floodplain restoration
  - stormwater system retrofits

- **Disturbed urban streams: complicated & difficult to restore**

- **Urban streams are valuable resources that should be protected/restored**

- **Planning can help prevent future "heavily degraded" situations in Maine**

THANK YOUs

- MDEP Biomonitoring Unit (Leon Tsomides, Tom Danielson, Susan Davies)
- SWAT (Surface Water Ambient Toxics) Program
- Brunswick Naval Air Station
- Others (Jeff Dennis, Chandler Morse, Mike Smith, John Field, John Reynolds)
- MDEP Staff, Interns and Volunteers